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Sustainable Literacy of Climate Chance: A Survey Study on Pre Service Elementary Teachers

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Abstract

Sustainability literacy is a crucial skill that should be introduced to students as a way to achieve sustainable development. Environmental issues are one of the main goals in sustainable development. The objective of this study is to analyze the sustainability literacy profile of pre-service elementary teachers related to climate change. This research is a survey study. The subjects of this study are 156 pre-service elementary teachers. Data collection techniques used semi-open questionnaires. Data analysis techniques used descriptive techniques. The results of the analysis show that the sustainability literacy of the students falls into the very good category, with an average score of 84.85%. The Sustainable Knowledge (SK) dimension is the highest compared to the other dimensions, with a percentage of 92.96%. Meanwhile, the Sustainable Behaviour (SB) dimension is the lowest, with a percentage of 76.75%.

Keywords: Sustainable literacy, climate change, environmental, sustainable development

Introduction

The issue of climate change has become one of the global issues that has received serious attention in recent decades (Gunamantha & Dantes, 2019) and is one of the most critical global issues (Doğan & Tüzer, 2011; El-Zein et al., 2021; IPCC, 2007; Ünal, 2023; WEF, 2021). This is reflected in the Paris Agreement, which states that to address climate change and its negative impacts, people around the world must cooperate to reduce greenhouse gas emissions, the main cause of climate change on Earth (United Nations, 2015). Climate is an important factor affecting the environment and human life (Ünal, 2023). Climate change is characterized by a rise in average temperatures, increased temperatures, and the severity of extreme weather. Climate change occurs due to long-term irregularities resulting from natural processes and human activities that disrupt the Earth's atmospheric balance (Türkeş, 2012). Studies reveal that the impacts of climate change include rising temperatures and a decrease in water resources (Varol et al., 2021) as well as an increase in natural disasters such as wildfires, droughts, floods, and erosion (Chugunkova & Pyzhev, 2020; UNCCS, 2019). The serious impacts of climate change make it one of the 17 main sustainable development goals (SDGs). There are three targets in the sustainable development goals for addressing climate change: strengthening resilience and adaptive capacity to climate-related hazards and natural disasters, integrating climate change measures into national policies, strategies, and planning, and enhancing education and raising awareness about the impacts of climate change (United Nations, no year).

One target in the climate change mitigation strategy is to enhance education and awareness about the impacts of climate change. Individual responses to climate change are believed to not only have direct and indirect effects on efforts to combat global warming but also impact climate change, which in turn affects sustainable development and human welfare (Pan et al., 2023). Therefore, educational institutions should rightly emphasize the significant impact of climate change on the environment (Gunamantha & Dantes, 2019). Climate change education is one of the four core programs in the Climate Change Initiative, which includes knowledge about climate change, culture and biodiversity, cultural heritage, and ethics, social, and humanitarian aspects (UNESCO, 2010). Thus, by introducing climate change education, it is hoped that it can help society, especially the younger generation, to understand and address climate change issues, promote sustainable lifestyles, and adapt to changing local conditions (UNESCO, 2010). This awareness should shape environmental literacy and even sustainability literacy for students. Awareness of environmental preservation is an essential aspect of developing environmental literacy towards sustainability literacy.

Sustainability literacy is the type of literacy needed to achieve the goals of sustainable development (Ozdemir, 2023; Vilmala et al., 2022). The expansion of the meaning of environmental literacy to sustainability literacy is due to the transition from environmental education to sustainable education (Leiva-Brondo et al., 2022). Sustainability literacy has become a key outcome in sustainable education, serving as a competency for the transition towards a sustainable society (Leiva-Brondo et al., 2022; Winter & Cotton, 2012). Individuals with sustainability literacy are able to understand the symbiotic relationship between the environmental, social, and economic dimensions of sustainable development. They can integrate appropriate knowledge with skills and further recognize and appreciate sustainable actions taken by others (Ozdemir, 2023). According to Mason, sustainability literacy is understood as the knowledge, skills, and mindset that enable individuals to be highly committed to building a sustainable future and to assist others in making appropriate and effective decisions towards a sustainable society (Mason & Sulitest, 2019).

There have been many studies examining sustainability literacy as a form of environmental awareness. For example, research conducted by Putri et al. found that students' sustainability literacy, particularly their perceptions of environmental change, is still low. Therefore, it is recommended to introduce sustainability literacy regarding environmental issues at the higher education level. Active teaching and learning about sustainability literacy are solutions that can be implemented to improve sustainability literacy (Putri et al., 2023). Adam et al. analyzed science education's impact on students' sustainability literacy. Through experimental methods, it was found that the increase in sustainability literacy fell into the low category in

science education, especially from the environmental aspect, which was also in the low category (Adam et al., 2021). Vilmala et al. conducted a survey of 45 science education program students about sustainability literacy using questionnaires and multiple-choice questions, showing that 50.87% of students had good knowledge, 68.78% were confident in their skills in dealing with sustainable environmental issues, 79.78% were confident in their sustainable attitudes towards environmental issues and problems, and 65% could explain the complexity of sustainability topics (Vilmala et al., 2022). Previous studies have extensively examined the measurement of students' sustainability literacy. However, there has been little research focusing on sustainability literacy emphasizing climate change issues for pre-service elementary teachers. The elementary school level is where students are at their golden age and have high levels of creativity, making it essential to develop skills, particularly the introduction of sustainability literacy, from an early age (UNESCO, 2010). Therefore, pre-service elementary teachers must have sustainability literacy regarding environmental issues, focusing on climate change, before teaching it to elementary school students.

Based on the above explanation, the purpose of this study is to explore the sustainability literacy of pre-service elementary teachers on climate change issues. The research question of this study is: What is the profile of sustainability literacy on climate change for pre-service elementary teachers?

Methods

This study used a survey method. The subjects of the research were 156 pre-service elementary teachers from both public and private universities in Central Java. The selected respondents were those who had received material on environmental issues, particularly climate change. The data collection technique used a semi-open questionnaire, specifically the Sustainability Literacy questionnaire adopted from Ozdemir (Ozdemir, 2023). Sustainability Literacy has four dimensions: Sustainable Attitude (SA), Sustainable Behaviour (SB), Sustainable Knowledge (SK), and Sustainable Perception (SP). SA uses a Likert scale divided into the sub-dimensions of "concern/worry," "social responsibility," and "locus of control". The SA items assess respondents' responses with five answer alternatives (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). The SB dimension uses a Likert scale to indicate the frequency of behaviors in daily life (1 = never, 2 = very rarely, 3 = sometimes, 4 = often, 5 = always). SB is designed with the sub-dimensions of "consumption pattern," "household use," and "participation." The SK dimension uses multiple-choice and closed-form tests that address environmental issues related to climate change. Meanwhile, the SP dimension consists of multiple-choice questions and two open-ended statements. The multiple-choice questions cover the perception of danger, the meaning of sustainability, and participants' perceptions of the most effective ways to achieve sustainability transition. The open-ended questions ask for examples of sustainability and unsustainability in the surrounding environment and suggestions to promote sustainability. Descriptive analysis was used to examine the data, considering the average scores and scores derived from the scale dimensions.

Result

This research focuses on the sustainability literacy profile of preservice elementary teachers. The study was conducted with 156 respondents. Figure 1 shows the profile of the students by gender.

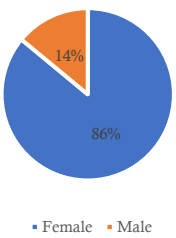

Figure 1. Student Profile by Gender

Figure 1 shows that the students participating consist of 14% males and 86% females. The majority are females because the selected students are preservice elementary school. Sustainability literacy is divided into four dimensions: Sustainable Attitude (SA), Sustainable Behaviour (SB), Sustainable Knowledge (SK), and Sustainable Perception (SP). For the SA and SB dimensions, sustainability literacy is measured using a Likert scale with five answer alternatives. The criteria for sustainability literacy (in percentage) are Very High (81-100), High (61-80), Sufficient (41-60), Low (21-40), and Very Low (0-20). Figure 2 shows the sustainability literacy of the students across the four dimensions.

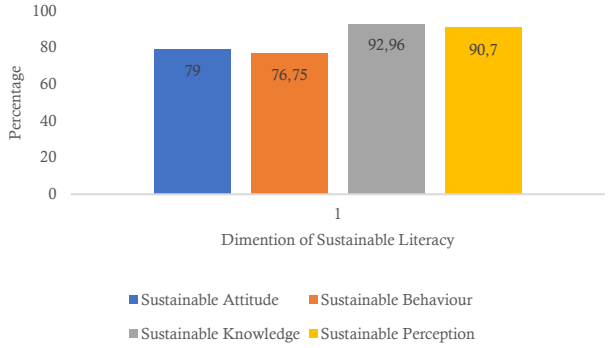

Figure 2. Sustainability Literacy Profile of Preservice Elementary Teachers Regarding Climate Change

Figure 2 shows that the sustainability literacy of the students falls into the very good category with an average score of 84.85%. The Sustainable Knowledge (SK) dimension is the highest compared to the other dimensions, with a percentage of 92.96%. Meanwhile, the Sustainable Behaviour (SB) dimension is the lowest, with a percentage of 76.75%. Based on the analysis, the Sustainable Knowledge and Sustainable Perception of preservice elementary teachers regarding climate change indicate a very high category.

1.1. Sustainable Attitude (SA)

Based on the analysis results, the Sustainable Attitude (SA) dimension in sustainability literacy indicates a high category with a percentage of 79%. SA consists of three sub-dimensions: Concern/worried, Social responsibility, and Locus of control. SA measurement uses a Likert scale questionnaire. SA items assess respondents' responses with five answer alternatives (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree).

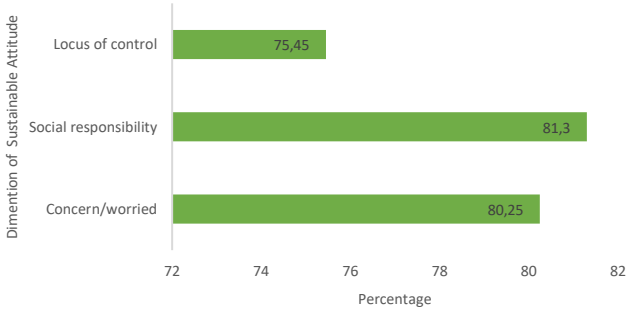

Figure 3. Percentage of Sub-Dimensions of Sustainable Attitude (SA) of Students

Figure 3 illustrates the sub-dimensions of Sustainable Attitude (SA), which fall into the high category with an average percentage of 79%. The aspect of social responsibility is a sub-dimension that has a higher percentage compared to the other sub-dimensions, obtaining a percentage of 81.30%.

1.2. Sustainable Behaviour (SB)

Based on the analysis results, the Sustainable Behaviour (SB) dimension in sustainability literacy indicates a high category with a percentage of 76.75%. SB consists of three sub-dimensions: consumption pattern, household use, and participation, which are measured using a Likert scale with five answer alternatives (1 = never, 2 = very rarely, 3 = sometimes, 4 = often, 5 = always). Figure 4 represents the overall percentage overview of the Sustainable Behaviour (SB) dimension.

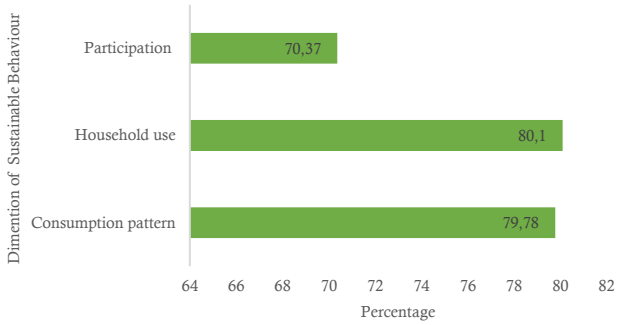

Figure 4. Percentage of Sub-Dimensions of Sustainable Behavior (SB) of Students

Figure 4 illustrates the sub-dimensions of Sustainable Behavior (SB), which fall into the high category. The household use aspect is a sub-dimension that has a higher percentage compared to the other sub-dimensions.

1.3. Sustainable Knowledge (SK)

Based on the analysis results, the Sustainable Knowledge (SK) dimension in sustainability literacy indicates a very high category with a percentage of 92.96%. The SK dimension includes multiple-choice and closed-ended questions that address environmental issues related to climate change. SK consists of two sub-dimensions: Environmental Processes, Natural sources, human use, and environmental degeneration. The multiple-choice questions provided relate to the material on climate change caused by the indiscriminate use of electricity and improper waste disposal into the environment.

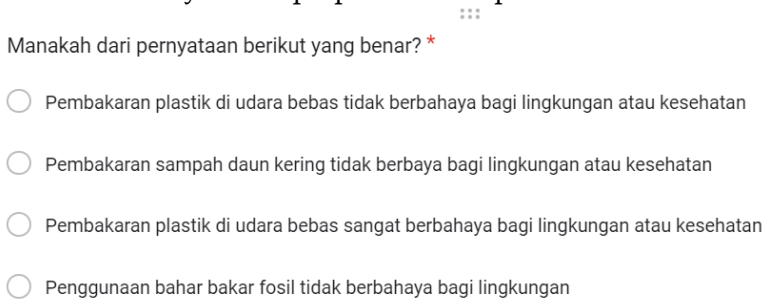

Figure 5. Example question format to measure the Sustainable Knowledge (SK) dimension

The analysis results indicate that the Sustainable Knowledge (SK) dimension shows a very high category with an average percentage of 92.96%. This result shows that the majority of respondents understand the concept of climate change that impacts the environment.

1.4. Sustainable Perception (SP)

Based on the analysis results, the Sustainable Perception (SP) dimension in sustainability literacy indicates a very high category with a percentage of 90.7%. The SP dimension consists of multiple-choice questions and two open-ended statements. The multiple-choice questions cover the perception of danger, the meaning of sustainability, and participants'

perceptions of the most effective ways to achieve sustainability transition. The open-ended questions ask for examples of sustainability and unsustainability in the surrounding environment and suggestions to promote sustainability.

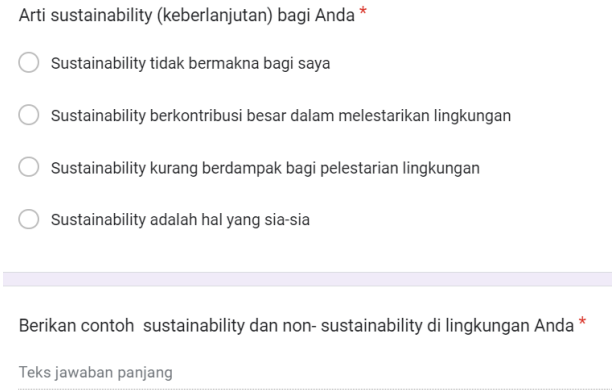

Figure 6. Example question format to measure the Sustainable Perception (SP) dimension

The analysis results indicate that the Sustainable Perception (SP) dimension shows a very high category with an average percentage of 90.7%. The majority of respondents are able to provide answers related to sustainability, particularly regarding climate change.

Discussion

The aspect of social responsibility in SA dimention measured is the concern for the environment, such as excessive use of natural resources like gasoline and excessive electricity consumption, which results in the emission of carbon dioxide gases. This contributes to climate change on Earth. The analysis also states that statements about concern for environmental degradation show that the majority of preservice elementary teachers strongly agree. Another analysis in the locus of control sub-dimension also yields responses relevant to other sub-dimensions. For example, the majority of respondents are concerned about the extinction of species due to an unfriendly environment. This response aligns with the results of other statements in the concern aspect, where the majority of preservice elementary teachers strongly agree that with intention and commitment, individuals can contribute to environmental quality by adopting good behavior. These findings are consistent with research conducted by several researchers on the positive impact of environmental attitudes on environmental sustainability (Baierl et al., 2022; Kaiser & Mayer, 2019; Rahardjanto et al., 2022; Soeharso et al., 2023). Siregar et al. found that locus of control influences pro-environmental attitudes (Siregar et al., 2022).

The household use aspect measured in SB dimenstion is behavior carried out in daily life related to climate change, such as turning off lights and electrical appliances when not in use, conserving water, and using the washing machine when the laundry load is full. These statements relate to sustainable behavior aimed at preserving the environment. Excessive electricity consumption contributes to increased temperatures, thus contributing to global warming. This is relevant to research findings by several researchers indicating that electricity usage impacts global warming. This is because electricity derived from fossil fuels causes severe environmental damage. When fossil fuels are burned, they emit gases containing toxic substances, such as carbon dioxide gas. On the other hand, the combustion of fossil fuels also contributes to significant air pollution when inhaled by humans and other organisms, posing health risks (Aljamali et al., 2021; Burillo, 2019; Gonseth et al., 2017; Sasana et al., 2023; Zhang et al., 2022). This sub-dimension is the highest (80.10%) compared to the other sub-dimensions. These results relate to attitudes practiced daily. Understanding the material on global warming caused by the effects of daily activities that are not wise allows students to use energy more wisely.

The high understanding of respondents regarding climate change impacts their attitudes and behaviors in environmental conservation. This result is consistent with research conducted by several researchers indicating that students' environmental knowledge correlates positively

with their attitudes toward the environment (Desriana, 2020; Hernanda et al., 2023; Purboyo et al., 2022; Sasea et al., 2023; Siswono et al., 2020; Sueb et al., 2021; Varoglu et al., 2017). Hernanda et al. explain that as a form of environmental conservation, individuals' knowledge and attitudes toward environmental conservation are crucial, and strengthening the aspect of environmental knowledge should be continuously pursued (Hernanda et al., 2023).

Having a positive perception of Sustainable literacy has a positive impact on the knowledge, attitudes, and behaviors of preservice elementary teachers regarding the threat of climate change on Earth. This result is consistent with research conducted by several other researchers (Ajayi et al., 2024; Choudri et al., 2016; Nahar et al., 2023; Solina et al., 2022; Sueb et al., 2021). Seco Pon et al. mention that there is a strong relationship between perception, knowledge, and attitudes toward environmental issues, especially those related to waste and its impact on ecosystems and organisms in the sea (Seco Pon et al., 2022). Besides disturbing marine organisms, plastic waste also affects climate change and health. Plastic waste is estimated to be responsible for 4.5% of global greenhouse gas emissions (Cabernard et al., 2021). This is because plastic waste releases gases such as methane and carbon dioxide, contributing to greenhouse gas emissions (Okunola A et al., 2019; Shen et al., 2020; Vishwakarma, 2020; Yadav et al., 2020). In addition, plastic waste burned directly releases sixteen polycyclic aromatic hydrocarbon compounds into the environment, which negatively impact human health, including cancer, respiratory diseases, and obesity in children who inhale them (Praveenkumar et al., 2024). Plastic waste that turns into microplastics and nanoplastics in the human body can trigger cancer, digestive disorders, stunted growth, shortened lifespan, and reproductive system disorders (Erawati, 2024).

Conclusion

The analysis results indicate that the sustainability literacy of students shows a very good category with an average of 84.85%. The Sustainable Knowledge (SK) dimension is the highest among the dimensions with a percentage of 92.96%. Meanwhile, the Sustainable Behaviour (SB) dimension is the lowest with a percentage of 76.75%. The Sustainable Knowledge and Sustainable Perception of preservice elementary teachers regarding climate change show a very high category. The high dimensions of SK and SP have an impact on the development of other dimensions, namely SB and SA. Thus, there is a relevant relationship between these four dimensions consistently in measuring the profile of sustainability literacy of preservice elementary teachers. This research can be a recommendation for science educators to promote and enhance sustainability literacy regarding climate change through concrete science learning based on environmental issues. One science learning model that can be recommended is the inquiry-based learning model based on environmental issues (SSIBL/Socio-Scientific Inquiry Based Learning) (Ariza et al., 2021).

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